Welcome

Shelley Row, P.E., PTOE Director
ITS Joint Program Office
Shelley.Row@dot.gov

WWW.PCB.ITS.DOT.GOV/STANDARDSTRAINING
A202
Identifying and Writing User Needs
When ITS Standards Do Not Have
SEP Content
Target Audience

- Engineering Staff
- Project Managers
Instructor

Raman K Patel, Ph.D., P.E.
President
RK Patel Associates, Inc.
New York, NY, USA
Curriculum Path (SEP)

- I101 Using ITS Standards: An Overview
- A101 Introduction to Acquiring Standards-based ITS Systems
- A102 Introduction to User Needs Identification
- A201 Details on Acquiring Standards-based ITS Systems
- Understanding User Needs
  - A311a NTCIP 1203
  - A313a NTCIP 1204 v03
  - A321a TMDD v3.0
- Specifying Requirements
  - A311b NTCIP 1203
  - A313b NTCIP 1204 v03
  - A321b TMDD v3.0
Curriculum Path (Non-SEP)

I101
Using ITS Standards: An Overview

A101
Introduction to Acquiring Standards-based ITS Systems

A102
Introduction to User Needs Identification

A201
Details on Acquiring Standards-based ITS Systems

A202
Identifying and Writing User Needs When ITS Standards Do Not Have SEP Content

A103
Introduction to ITS Standards Requirements Development

A203
Writing Requirements When ITS Standards Do Not Have SEP Content

*A3xxa
Identifying and Writing Specific User Needs for NTCIP 12xx vxx

*A3xxb
Developing and Writing Specific Requirements for NTCIP 12xx vxx

* Expected in year 2 training modules
Recommended Prerequisites

- I101: Using ITS Standards: An Overview
- A101: Introduction to Acquiring Standards-based ITS Systems
- A102: Introduction to User Needs Identification
- A201: Details on Acquiring Standards–based ITS Systems
Recommended Prerequisites (cont.)

- Basic knowledge of the following areas is helpful:
  - Intelligent Transportation Systems (ITS)
  - Managing ITS Deployment Projects
  - Government Procurement Processes
  - Benefits of Standards
  - Systems Engineering Process (SEP)
Learning Objectives

1. Understand Role of User Needs
2. Understand Structure of Standards
3. Analyze Concept of Operations for User Needs
4. Write a User Need
5. Extract User Needs from other Relevant Standards
6. Validate User Needs
Understanding Role of User Needs

- ITS Standards
  - Data-Communications-Equipment

- with SEP Content
  - User Needs Documented
  - Agencies Select User Needs

- without SEP Content
  - User Needs NOT Documented
  - Agencies Infer User Need
How do Standards Support Operational Needs?

- NTCIP device standards provide the interface to facilitate remote access of the field devices to:
  - Configure the device
  - Monitor the device
  - Control the device (functions)
  - Retrieve information from the device

- System standards provide the interface to conduct information exchanges among centers
NTCIP Device Standards

Facilitate Remote Access of the Field Devices

Standards with SEP Content
- Environmental Sensor Stations
- Dynamic Message Signs
- Electrical Lighting Management Systems
- Signal Control Priority
- Traffic Sensor Systems
  - Work in progress, Field Management Stations Part 1 for SSM

Standards without SEP Content
- Actuated Signal Controllers
- CCTV Cameras
- Ramp Meter Control Units
- Data Collection & Monitoring
- Video Switching
- Network Cameras

Center to Field (C2F)
Where do Standards Fit?

Mixed use of Device & System Standards
**What Should be in a Specification?**

- **Description** of what the interface must do to support operations (features-functions)

- **Written** in “shall” language specific functional requirements to satisfy user needs

- **Allocation of** only standard-supplied design data concepts-objects to fulfill the stated requirements
Problem Definition

What should we do when user needs do not already exist?

Enter your response in the chat pod
Develop User Needs When They do not Already Exist

- Module A102 focused on user needs
- Certain standards do not have user needs
- We must first discover them from various sources and standards, and then write them
Why do we Have to Write User Needs?

- Allow tracking development at all stages
- They eliminate “guessing or assuming” by developers
- Other reasons…..
Other Reasons
Consideration for Interoperability

- TMC may need to communicate messages with external centers in the region involving field devices
Other Reasons Consideration for Vendor Independence

- Agencies desire multiple (devices/parts) suppliers, interchangeability
User Needs Locations on “V” Model

Multiple Stakeholders Needs Assessed
Operational Problem Solving Needs & Agreement
Reassessment Gaps-New Needs

Regional Architecture(s)
Feasibility Study / Concept Exploration
Concept of Operations
System Validation Plan
System Validation
System Verification Plan (System Acceptance)
System Verification & Deployment
Subsystem Verification
Subsystem Verification Plan (Subsystem Acceptance)
Unit / Device Test Plan
Unit/Device Testing
High-Level Design
Detailed Design
Software / Hardware Development
Field Installation
Implementation
Development Processes
Operations and Maintenance
Changes and Upgrades
Retirement / Replacement

Time Line
Document/Approval

Learning Objective # 1

RITA U.S. Department of Transportation Research and Innovative Technology Administration
Users’ Perspective

- What the system must do to support operational needs:
  - Features/functions
- Support for:
  - Operation Staff-TMC Operators
  - Traffic and System Engineers
  - System Maintenance
Understanding Structure of Standards (1)

- SEP-based Standards provide the following Documented Content:

  - User Needs
  - Requirements
  - Design Concepts
Example of SEP-based Content

2.5.2.5 Monitor Water Level
A transportation system operator may need to monitor the depth of water at one or more locations (e.g., over a roadway, in a stream, of a reservoir, etc.).

3.5.2.3.7 Retrieve Water Level
Upon request, the ESS shall return the current depth of water at defined locations (e.g., over a roadway, in a stream, of a reservoir, etc.).

<table>
<thead>
<tr>
<th>Req ID</th>
<th>Dialog</th>
<th>Requirement</th>
<th>Object ID</th>
<th>Add'l Requirements/Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2.3.7</td>
<td>F.4.6</td>
<td>Retrieve Water Level</td>
<td>5.8.19</td>
<td>waterLevelSensorTableNumSensors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.8.21.1</td>
<td>waterLevelSensorIndex</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.8.21.2</td>
<td>waterLevelSensorReading</td>
</tr>
</tbody>
</table>

Source: NTCIP 1207 ESS standard
Understanding Structure of Standards (2)

- Non-SEP-based Standards Provide Documentation for:
  - Design Concepts
  - Some designs such as dialogs may be missing

- We will learn to explore and distinguish user needs from requirements that drive the design
Device Standard with SEP Content

Table of Content

Section 1: Concept of Operations/User Needs
Section 2: Functional Requirements
Section 3: Dialogs
Section 4: Management Information Base-MIB
Section 5: Protocol Requirements List-PRL
Example of Standard with SEP: NTCIP 1203 v3.03 April 2011

Section 1 GENERAL [Informative] ............................................................................................................................................. 1

Section 2 CONCEPT OF OPERATIONS [Normative] .................................................................................................................. 19

Section 3 DMS FUNCTIONAL REQUIREMENTS [Normative] ...................................................................................................... 32

Section 4 DIALOGS [Normative] .................................................................................................................................................. 98

Section 5 MANAGEMENT INFORMATION BASE (MIB) [Normative] ...................................................................................... 132

Section 6 MARKUP LANGUAGE FOR TRANSPORTATION INFORMATION (MULTI) [Normative] .. 215

Annexes
Device Standard without SEP Content

Table of Contents

Section 1: Overview
Section 2: General
Section 3: Management Information Base-MIB
Section 4: Conformance Groups (CGs)
System Standard Without SEP Content

Table of Content

Section 1: Requirements
Section 2: Dialogs
Section 3: Message Sets
Section 4: Data Frames-Data Elements

Example

IEEE Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers
Recap

- User Needs:
  - Discussed in Module A102
  - Form the basis for system development
  - Create a path (first step) to interoperability and vendor independence
- We have learned to explore the structure of a standards to prepare specification
POLLLING
Has Your Region Developed a Regional Architecture?
Analyzing ConOps for User Needs

- ConOps Reveals a “Big Picture”:
  - What is the current situation or problem?
  - Who are the users? Who is affected?
  - What are the operational scenarios?
  - Are there any regional aspects?
Where to Find User Needs

- ConOps/Project Concept
- Operational Scenarios
- Regional Architecture
Where to Find User Needs (cont.)

- Stakeholders-Interviews
- Assessment Workshops
- Case Studies-Lessons
What to Look for in a ConOps?

- What you want to do operationally?
- Specific systems and their intended uses
- What are the expected regional interactions?
Operational Scenarios

- Scenarios are key part of ConOps:
  - What is to be done? (Task)
  - Who will do what? (Roles)
  - What is to be communicated? (Information)

- Scenarios are managed using Standard Operating Procedures (SOPs)
  - Based on lessons learned from the past events
  - Carried out by TMC operators
Summary

- We know how to identify user needs from:
  - Regional architecture documents and stakeholders
  - ConOps and operational scenarios
  - Other standards
Steps to Writing a User Need

A  Operational Needs

B  ITS Standard

C  Extraction Process

D  Writing Criteria
Example: Exploring the Standard

Operational Need

A. Desire to control CCTV cameras from multiple locations during traffic incident management

B. NTCIP 1205 CCTV
Criteria for Writing a User Need (D)

- Give it a Structure
- Uniquely Identifiable
- Major Desired Capability
- Solution Free
- Capture Rationale

Don’t get into how-designing

Step “C” is discussed later

What functions?

Why do we need it?
User Need (Structure)

UN ID # | UN Title
--- | ---
UN 1.1 | Control a CCTV camera from more than one location

**Uniquely Identifiable** throughout the project development

Reflects the purpose and the context of an operation

Allows tracing of the requirements and helps to validate a “built” system/device
User Need (Meaning)

write a major desired capability

“This feature addresses the need for a CCTV camera to be *controlled remotely* from one or more locations on roadways to *manage congestion* in the region.”

Capture a rationale

keep it solution-free
Name a standard without SEP content

Enter your response in the chat pod
Extracting User Needs from Relevant Standards

How should we do this?
Management Information Base (MIB)

- MIB contains related **objects** definitions
- Objects represent management information

e.g. CCTV MIB contains 70 objects in lexicographical order of their OBJECT IDENTIFIERS correspond to their physical location in the global naming tree (12 nodes).
Purpose of Objects

- NTCIP Objects are designed to be managed (manipulated) for configuring the device, monitoring the device and controlling the device.

Example:

(SET is one of the commands used to “tell” the device what to do)

- C  Control Objects
- P  Parameter objects
Structure of an Object

- Defined by the Abstract Syntax Notation 1 Language (ASN.1)

1. Object’s name
2. Data type value range
3. Read-write only
4. Conformance requirement
5. Human readable description, purpose
6. Object Identifier (OID)

3.2.1 maximum number of Presets parameter

```plaintext
rangeMaximumPresets OBJECT-TYPE
SYNTAX   INTEGER (0...255)
ACCESS   read-only
STATUS   mandatory
DESCRIPTION “A preset is the pre-specified position where a camera is pointed to a fixed point in space……”
::={cctvRange1}
```
Managed Object

1. To manage an object the Standard assigns a wide range of values to select from as needed: e.g. 8 phases traffic controller is required

maxPhases OBJECT-TYPE
SYNTAX INTEGER (2..255)
ACCESS read-only
STATUS optional
DESCRIPTION
"<Definition> The Maximum Number of Phases this Actuated Controller Unit supports. This object indicates the maximum rows which shall appear in the phaseTable object.
<DescriptiveName> NTCIP-1202::ASC.maxPhases
<DataConceptType> Data Element
<Unit> phase"
::= { phase 1 }

2. To manage this object the Standard has fixed its location on the Internet tree of nodes by providing an unique ID number
Summary of what an object does

- Data content is a Pairing of \([OID, Value]\)
  - Fulfills a requirement (design)
  - Becomes part of the message sent to the device to perform a desired action
- Future PCB module will cover this topic
Conformance Group (CG)

- A CG is a logical grouping of related objects.
- CG helps in determining required objects to support a function.
- One CG for one function
Conformance Group (CG)

Example: *Motion Control CG*
Lists objects necessary to meet user requirement for the remote control of a camera

Objects are gathered from the MIB

They form a logical grouping

- presetGotoPosition
- presetStorePosition
- positionPan
- positionTilt
- positionZoomLens
- positionFocusLens
- positionIrisLens
Conformance Group (cont.)

- CGs are used to check the conformance to the standard:
  - **Mandatory** CGs must be selected
    - Example: CCTV Configuration
  - **Optional** CGs may be selected by user
    - Example:
      - Extended Functions
      - Motion Control
      - On-Screen Menu Control
(Suggested) Extraction Process (C)

- **READ**
  - Conformance Groups
  - MIB (Objects)

- **RECOGNIZE**
  - Categories of Functions
  - Functionality

- **INFER**
  - Major Desired Capability
  - Requirement Design
There are 4 CGs

<table>
<thead>
<tr>
<th>CONFORMANCE GROUP</th>
<th>REFERENCE</th>
<th>CONFORMANCE REQUIREMENT</th>
</tr>
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<tbody>
<tr>
<td>Configuration</td>
<td>NTCIP 1201:1996</td>
<td>mandatory</td>
</tr>
<tr>
<td>Database Management</td>
<td>NTCIP 1201:1996, Amendment 1</td>
<td>optional</td>
</tr>
<tr>
<td>Time Management</td>
<td>NTCIP 1201:1996, Amendment 1</td>
<td>optional</td>
</tr>
<tr>
<td>CCTV Configuration</td>
<td>NTCIP 1205</td>
<td>mandatory</td>
</tr>
<tr>
<td>Extended Functions</td>
<td>NTCIP 1205</td>
<td>optional</td>
</tr>
<tr>
<td>Motion Control</td>
<td>NTCIP 1205</td>
<td>optional</td>
</tr>
<tr>
<td>On-Screen Menu Control</td>
<td>NTCIP 1205</td>
<td>optional</td>
</tr>
</tbody>
</table>

Source: NCIP 1205 v1 pages 4-5
We recognize that these four CGs represent four major functionalities.

These four CGs collect 70 objects (design) from 12 listed categories under CCTV MIB. (NTCIP 1205)
INFER

Potential User Needs

- Review Operational Context:
  - Provide CCTV functions to support traffic management in the region.

- Outline Desired Features:
  - The features identify and describe the various functions that users may want the device to perform. These features are derived from the high level user needs identified in the problem statement.
Potential CCTV User Needs (partial list)

1. TMC operator may need to configure a CCTV device
2. TMC operator may need to control the features within a CCTV
3. TMC operator may need to control Pan-Tilt-Zoom features to position the camera
4. TMC operator may need to activate the internal camera menu and manipulate control parameters

User needs can be broken down as sub-needs
ASC Example

- Operational context:
  - Remote access from TMC to Configure, Monitor, and Control ASC for:
    1. Intersection Control
    2. Overlap
    3. Coordination (local)
    4. Coordination (central)
    5. Priority/Preemption
    6. Reporting
    7. Special Functions
    8. Intra-cabinet Communications
NTCIP 1202 v02 ASC

- 15 CGs are categorized as per functional areas
- A.3 and A.4 are Mandatory for Conformance

<table>
<thead>
<tr>
<th>Ref</th>
<th>Areas</th>
<th>Clause of Profile</th>
<th>Status</th>
<th>Support</th>
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<tr>
<td>A.3</td>
<td>Phase Conformance Group</td>
<td>NTCIP 1202 - 2.2</td>
<td>M</td>
<td>Yes</td>
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<tr>
<td>A.4</td>
<td>Detector Conformance Group</td>
<td>NTCIP 1202 - 2.3</td>
<td>M</td>
<td>Yes</td>
</tr>
<tr>
<td>A.5</td>
<td>Volume Occupancy Report Conformance Group</td>
<td>NTCIP 1202 - 2.3</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.6</td>
<td>Unit Conformance Group</td>
<td>NTCIP 1202 - 2.4</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.7</td>
<td>Special Function Conformance Group</td>
<td>NTCIP 1202 - 2.4</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.8</td>
<td>Coordination Conformance Group</td>
<td>NTCIP 1202 - 2.5</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.9</td>
<td>Time Base Conformance Group</td>
<td>NTCIP 1202 - 2.6</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.10</td>
<td>Preempt Conformance Group</td>
<td>NTCIP 1202 - 2.7</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.11</td>
<td>Ring Conformance Group</td>
<td>NTCIP 1202 - 2.8</td>
<td>O</td>
<td>Yes / No</td>
</tr>
<tr>
<td>A.12</td>
<td>Channel Conformance Group</td>
<td>NTCIP 1202 - 2.9</td>
<td>O</td>
<td>Yes / No</td>
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<tr>
<td>A.13</td>
<td>Overlap Conformance Group</td>
<td>NTCIP 1202 - 2.10</td>
<td>O</td>
<td>Yes / No</td>
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<td>A.14</td>
<td>TS 2 Port 1 Conformance Group</td>
<td>NTCIP 1202 - 2.11</td>
<td>O</td>
<td>Yes / No</td>
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<td>A.15</td>
<td>Block Object Conformance Group</td>
<td>NTCIP 1202 - 2.12</td>
<td>O</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

Additional CGs are also needed from other standards (see NTCIP 1202 v02-2005 standard page 135)
## List of User Needs for ASC

Source: NTCIP 1202 v02, page 135

<table>
<thead>
<tr>
<th>UN</th>
<th>User Need</th>
<th>Mapped to these CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intersection Control</td>
<td>• A.3 Phasing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.4 Detector</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.6 Unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.11Ring</td>
</tr>
<tr>
<td>2</td>
<td>Overlap</td>
<td>• A.13 Overlap</td>
</tr>
<tr>
<td>3</td>
<td>Coordination (local)</td>
<td>• A.17 Time Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.18 Time Event Schedule</td>
</tr>
<tr>
<td>4</td>
<td>Coordination (central)</td>
<td>• A.5 Volume Occupancy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.3 Phase</td>
</tr>
<tr>
<td>5</td>
<td>Priority/Preemption</td>
<td>• A.10 Preempt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.7 Special Function</td>
</tr>
<tr>
<td>6</td>
<td>Reporting</td>
<td>• A.19 Report</td>
</tr>
<tr>
<td>7</td>
<td>Special Functions</td>
<td>• A.7 Special Function</td>
</tr>
<tr>
<td>8</td>
<td>Intra-cabinet Communications</td>
<td>• A.12 Channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A.14 TS 2 Port 2</td>
</tr>
</tbody>
</table>
UN 1.1 Maximum Number of Phase
The system owner needs to be able to manage the operation of the ASC at an intersection that may require support for minimum of eight phases to assign right of way, including pedestrian movements. This includes the ability to program in any combination of 2-8 phases.

Note 1: This UN is Mandatory as per CG A.3 of the ASC standard

Note 2: UN is written with ID, title, a major capability, with rationale and it is free of design that is it doesn’t say how it is to be met
Writing a User Need for CCTV

UN 1.1 Control a Remote CCTV Device

To support an area-wide surveillance of a roadway section a TMC operator may need to remotely access the CCTV device presets and control pan/tilt/zoom (PTZ):

- *Zoom and Focus Position Preset*
- *Tilt angle from = +40 to -90 deg.*
Writing User Needs Based on a Scenario

Incident Management

"a TMC operator receives information on a traffic incident and creates an incident report. The operator determines a list of centers who are affected, then begins to inform centers……At some point motorists must be informed…..media informed……"

UN # 1 Share incident information with the motorists
UN # 2 Provide warnings to the public
UN # 3 Share information with relevant authorized centers
Writing a User Need for Emergency Management

Example of IEEE 1512 Family of Standards

UN 1.1 Share Incident Information with First Responders
An EM center operator may need to know about the roadway incident (in real-time) to be able to make decision and dispatch first responders to the location immediately thereafter, resulting in improved incident response times thus saving lives.

• This User Need meets the following criteria:
  1. Uniquely Identifiable with ID + Title
  2. User Need with Major Desired Capability
  3. Rationale
  4. Solution-free
Acknowledging Risks

- Extraction process has some risks:
  - Two users may end up with different inferences
  - Interoperability may be hurt
  - Missing data must be developed
Traceability with CGs

- Ensures that user needs are met
- Ensures that objects are selected for requirement(s)

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>Conformance Group</th>
<th>Requirement</th>
<th>Objects Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Provide Remote Control….Zoom</td>
<td>4.1.1 CCTV Configuration</td>
<td>Provide a lens with capabilities for remote control of zoom operations</td>
<td>3.2.8 rangeZoomlimit 3.3.3 timeoutZoom</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.5.3 positionZoomlens</td>
</tr>
<tr>
<td></td>
<td>4.1.3 Motion Control</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Validating User Needs

Validation strategy is part of a ConOps Plan

Contains performance measures to assess outcomes

“Declare Victory” you have built the right thing… user needs are met

Focus is on User Needs at all stages
What Have We Learned Today?

1. When _____ _____ don’t already exist; we have to _______ them
2. User needs are a first step towards achieving _______________ and _______________
3. User needs can be found in a _______ plan
4. User needs can be derived from ____________, which are part of a _______ plan
What Have We Learned Today? (cont.)

5. Non-SEP based standard’s structure provide

Conformance Groups (CGs) and

Management Information Base (MIB)

6. This course taught us a four step extraction process:

Read, Recognize, Infer and Write.
What Have We Learned Today? (cont.)

7. User needs must be written using a prescribed criteria:

- Uniquely Identifiable
- Major desired Capability
- Capture Rationale
- Solution-free

8. System is [V]alidated with user needs
The participants will learn to:

- Identify different types of requirements.
- Understand that requirements development is a process.
- Avoid pitfalls when writing requirements.
- Write requirements when an ITS communication standard does not have SEP information.
- Use traceability matrices as tools for requirements development.
Table of Contents

Learning Objectives

- Understand Role of User Needs
- Understand Structure of Standards
- Analyze Concept of Operations for User Needs
- Write a User Need
- Extract User Needs from other Relevant Standards
- Validate User Needs

References
Additional Information Sources

- *Systems Engineering for ITS* Handbook, FHWA
- NTCIP Guide
- TMDD Guide
- IEEE 1512 Implementation Guide
Here are some questions....

• What is the difference between compliance and conformance?
• What is the difference between validation and verification process?
• Will there be training courses on CCTV or ASC type of devices?